Chapter 11 Testing

The Freeway Management System (FMS) construction culminates with a series of tests that confirm the full functionality of each component, subsystem, and the overall FMS. The Designer must understand the rationale for these tests, the actual test requirements and procedures, the required test equipment and how the tests are reported in a written document to the Inspector.

11.1 Original Testing Requirements

Originally there were six types of tests, including:

- Design Acceptance Test (DAT)
- Factory Demonstration Test (FDT)
- Factory Acceptance Test (FAT)
- Stand Alone Test
- Subsystem Acceptance Test (SST)
- System Acceptance Test (SAT)

These tests were consolidated into the Stored Specifications, specifically within Section 105.04 – Control of Work.

11.2 Discontinued Tests for Established Technology

Recently, several of these tests have been judged to be no longer required for established technology. Specifically, the DAT, FDT, and FAT are no longer required.

The DAT required the contractor to host the Design and Arizona Department of Transportation (ADOT) teams at the manufacturer's facility to verify mock-up models of FMS devices prior to actual production. This test was initially required given that the original system was considered not proven, thus giving an opportunity to bench test the FMS.

The FDT and FAT are further demonstrations of the FMS individual components at the manufacturer's facility. Like the DAT, these tests have not been required in the last several years for established technologies. Freeway Dynamic Message Signs (Freeway DMS), CCTV cameras, and several software packages are furnished by ADOT, with the other equipment (Type 341 and 343 cabinets, Type 179 and Type 2070 controllers, certain non-intrusive detection technology, and other communication equipment) now considered mature technologies, negating the need for these tests. In instances where a new vendor of a proven technology is being used for the first time, contractors have been required to submit certificates of compliance addressing the equipment and manufacture's compliance with specifications and compatibility with the ADOT FMS.

In each of these cases the need for specialized tests for the DAT, FDT, and FAT should be considered by the Designer. It is possible that one or all of these tests may need to be conducted in cases of truly new

technology, manufacturing technique, the implementation of a vastly different communication infrastructure or new system software deployment. The ADOT TTG project manager (PM) will be the judge on the need for the re-introduction of these tests.

11.3 Required FMS Testing in Current Practice

The other FMS tests (Stand Alone, SST, and SAT) are crucial to the successfully completion of the FMS construction. ADOT has gained considerable experience with the testing and results of these key tests. The Designer should consult with the ADOT TTG PM as to whether the Stored Specification for 105.04 is sufficient for the project. Existing FMS test procedures are available (see Section 3.1, Emerging Technology, *Approved Products List*). The specifications need to require the Contractor to develop test procedures for all equipment that does not have an existing procedure.

11.3.1 Stand Alone Test

The Stand Alone test is intended to verify the functionality of each FMS device (one by one) is fully compliant with the FMS standards. This test is conducted in the field at each individual FMS device location. The device must be proven to operate per specification independent of interconnection to the FMS software through the communication network. This test does not usually involve TOC personnel. After this test is complete all DMS signs on the project shall post a "Sign Under Test" message to alert motorists that the sign is not currently posting real time messages.

11.3.2 Subsystem Acceptance Test (SST)

The SST verifies the communications system and device communication firmware with the respective FMS equipment for each subsystem (CCTV cameras, Freeway DMS, ramp meters/count stations, etc.). Databases for each device type are typically updated and communication circuits are integrated at the Traffic Operations Center (TOC) by ADOT or a subconsultant to ADOT TOC. The contractor must notify the TOC 3 weeks prior to the start of this test to ensure that all communication software is updated for the project. Communication with each device in the network is then monitored from the TOC by ADOT for a set test period using test software developed by ADOT specifically for the ADOT FMS Databases. The test either passes or fails based on the number of errors, typically both over the entire test duration, typically 72 hours, and for a maximum number of errors within smaller durations of time.

11.3.3 System Acceptance Test (SAT)

The final test is a 30-day full System Acceptance Test, comprising of the proper operation of the overall system. This test is typically conducted by the operators at the TOC using test procedures that verify the system operates in as expected in day-to-day operations.

11.3.3.1 Minor Failures

Certain minor failures may lead to a stop of the test. The 30-day test shall be suspended for the entire system for the following minor failure conditions:

- Interference with project operations due to vandalism, traffic accident, power failure, or lightning for which lightning protection devices as specified are not sufficient protection

- Failure to complete the objective of any test scenario due to lack of adequate documentation for equipment supplied by the contractor. Failed tests shall be retested with revised documentation.
- Intermittent hardware, software, communication, or operation control malfunctions

Resumption of the test for the remainder of the 30-day period shall occur after satisfactory remedial action. For each restart, the 30-day test shall be extended by one day after the remediation is complete.

11.3.3.2 Major Failures

Major failures, or repetitive minor failures, may lead to a restart of the test upon correction of the issues. A major system failure is defined as one or more of the following conditions:

- Failure of any hardware or performance item to meet the operational requirements of the Special Provisions for 72 or more consecutive hours.
- Failure of 10 percent or more of the existing or new controllers within any 72-hour period.
- Failure of an individual unit of equipment 3 or more times within 5 days for different reasons.
- Failure of 5 percent or more of all detectors, detector cards, CCTV, communication equipment or AC isolators within a 14-day period.

Failure to correct any problem, as determined by the engineer, that adversely impacts the safety of the traveling public, within 4 hours of notification.

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